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**Hermit Crab of Portonovo Coast
(Decapoda : Anomura)**

by

S. AJMAL KHAN AND R. NATARAJAN

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Zoological Survey of India, Calcutta

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ZOOLOGICAL SURVEY OF INDIA

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Hermit Crabs of Porto Novo Coast

by

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INTRODUCTION

Studies on the infauna of Porto Novo waters (lat. 11 29 N , long. 79°46 E) have been in progress since the inception of the Marine Biological Station in the year 1956 (Anon., 1971, Natarajan, 1977). With the growth of this station as an Advanced Centre in Marine Research, a more extensive knowledge of the local fauna has become imperative. Not much was known about the systematics of most of the animal groups and therefore special emphasis was given to this aspect, so as to get a comprehensive idea of community structure and population dynamics of this area. Hermit crabs, the most interesting group of organisms among the decapod crustaceans occur in large numbers in Vellar estuary and are also found abundantly in the trawl catches of local mechanised vessels. Except for a note on the occurrence of a few species by Reddi (1935), practically no other information was available on these crabs from Porto Novo. An inventory made on its fauna, ecology and biology (Ajmal Khan, 1978) revealed the existence of 20 species (14 marine, 5 estuarine and 1 terrestrial) of hermit crabs under 7 genera which is presently reported with notes on sexual dimorphism, colour and distribution.

METHODS

Synonymies are not intended to be complete. The terminology used in the keys conform to the earlier works. Efforts were made to collect maximum number of specimens. Sexual dimorphism is described for all species except one (*Dardanus imbricatus*) in which only one specimen (female) was collected. The setal types of pleopods are found to vary in the two sexes and so the type of setae present in both sexes are elaborated. The following are the three different types of setae found on pleopods in the present study-types 1, 2 and 3 correspond to setal types 2, 5 and 6 of Robert (1968) respectively.

Type 1 seta

This robust seta can be separated into two portions. The proximal section is a nude cylinder. The distal portion tapers and is curved at its end. It bears two longitudinal rows of evenly spaced cuneate setules.

Type 2 seta

It is the plumose setae referred to by many authors. The setules are fine hair attached in two diametrically opposed rows.

Type 3 seta

This is more variable with longest and shortest setae either nude or with only a few randomly located hair-like setules, may be hooked at the tip.

SYSTEMATIC ACCOUNT

*Key to the superfamilies and families of tribe Paguridea of
Porto Novo coast*

- | | | | | | |
|----|--|-----|-----|-----|-----------------------------|
| 1 | Bases of third maxillipeds not separated by sternal plate | ... | ... | ... | Superfamily : |
| | A) Anternal flagellum ending in a tapered filament | ... | ... | ... | Coenobitoidea
Diogenidae |
| | B) Antennal flagellum ending bluntly | ... | ... | ... | Coenobitidae |
| 2. | Bases of third maxillipeds widely separated by a sternal plate | ... | ... | ... | Superfamily :
Paguroidea |
| | A) Sternal plate not divided | ... | ... | ... | Paguridae |

Superfamily : COENOBITOIDEA

Family : DIOGENIDAE

Key to the genera of the family Diogenidae

- | | | | | | |
|----|---|-----|-----|-----|--------------------|
| 1. | First two abdominal segments of male and first abdominal segment of female with paired appendages ; fourth pair of pereopod not chelate | ... | ... | ... | <i>Paguristes</i> |
| | No Paired pleopods present, fourth pair of pereopod chelate or sub chelate | ... | ... | ... | 2 |
| 2. | Chelipeds equal or subequal ; dactylar tips corneous and black, spooned ; dactylus open and close horizontally | ... | ... | ... | <i>Clibanarius</i> |
| | Left cheplid usually larger than right ; dactylar tips corneous or calcareous ; dactylus open and close obliquely | ... | ... | ... | 3 |
| 3. | Dactylar tips of chelipeds corneous and black ; rostrum obsolete ; setose fleshy spur present behind third pleopod | ... | ... | ... | <i>Dardanus</i> |
| | Dactylar tips of cheliped calcareous and white, rostrum replaced by a narrow lamina or spine | ... | ... | ... | <i>Diogenes</i> |

Genus Paguristes Dana

1852. *Paguristes* Dana, *Proc. Acad. nat. Sci. Philad.*, : 269.

1852. *Paguristes* Stimpson, *Proc. Acad. nat. Sci. Philad.*, : 235.

1905. *Paguristes* Alcock, *Cat. Indian Mus. Crust.*, : 34.

This genus is represented by a single species in Porto Novo waters.

Paguristes longirostris Dana (Fig. 1)

1952. *Paguristes longirostris* Dana, *Proc. Acad. nat. Sci. Philad.*, : 271

1905. *Paguristes longirostris* : Alcock, *Cat. Indian Mus. Crust.*, : 36.

Material

5 specimens (3 males and 2 females) collected from the trawl catches of local inshore waters were examined.

Sexual dimorphism

Male pleopods (Fig. 1 b, c, d) :

Number : 3
Nature : Uniramous
Setal type : 2

Female pleopods (Fig. 1 f, g, h, j)

Number : 4
Nature : 3 biramous and one uniramous
lower ramus of biramous pleopods
about half of upper ramus
Setal types : Biramous pleopods—type 2 and 3
Uniramous pleopod—type 2

Gonopods (Fig. 1 k, l)

Male : 2 pairs of gonopods present on I and II abdominal segments, gonopods of each side face each other (Fig. 1 k, 1, 2)
Female : 1 pair on I abdominal somite, different in structure from males (fig. 1, 1)

Colour

In live condition the carapace, chelipeds and walking legs are light brown in colour with pinkish patches. Eyestalks are violet in colour. Four violet blotches with a pink stripe on the inner and outer merus of both chelipeds are quite distinct in this species. Formalin preserved specimens are yellow in colour and the above colourations appear faded.

Distribution

Bay of Bengal

Remarks

This hermit crab is very rarely found in the trawl catches. It can be easily recognised by its violet coloured eyestalks. They were found to occupy the shells of *Murex tribulus* but were also collected from the shells of *Nassa dorsata* and *Nassaria nivea*.

Genus Clibanarius Dana

1852. *Clibanarius* Dana, *U. S. Expl. Exped Crust.*, : 461

1905. *Clibanarius* : Alcock, *Cat. Indian Mus. Crust.*, : 50.

1953. *Clibanarius* : Forest, *Bull. Mus. Hist. Nat. Paris*, : 437.

This genus is represented by five species in Porto Novo waters.

Key to the identification of Clibanarius species

1. Eyestalks shorter than antennular peduncle ; yellow longitudinal stripes on walking legs
 - A) Inner lower border of merus simply serrulate and spine absent... .. *clibanarius*
 - B) A strong spine at lower inner border of merus of cheliped *infraspinatus*
2. Eyestalks as long as antennular peduncle
 - A) Stripes on eyestalks
 - i) Hand rough with spinules ; crimson coloured stripes on eyestalks and on all legs, broken in cheliped *adavensis*
 - ii) Hand smooth and devoid of spinules red stripes on eyestalks ; no stripes on pereopods *olivaceus*
 - B) No stripes on eyestalks ; blue longitudinal stripes quite distinct on walking legs *longitarsus*

Clibanarius clibanarius (Herbst) (Fig. 2)

1791 *Cancer clibanarius* Herbst, *Krabben*, II(i), : 20.

1802. *Pagurus clibanarius* : Bosc, *Hist. Nat. Crust.*, II : 75.

1858. *Clibanarius vulgari* : Dana, *U.S. Expl. Exp. Crust.*, : 247.

1878. *Clibanarius clibanarius* : Hilgendorf, *MB. K. Akad., Berlin*, : 820.

1905. *Clibanarius clibanarius* : Alcock, *Cat. Indian Mus. Crust.*, : 43.

Material :

Large number of specimens ranging in size from 10 mm to 37 mm (Carapace length), collected from the trawl catches were examined.

Sexual dimorphism

Male pleopods : (Fig. 2b, c, d, e)

Number	4
Nature	: Biramous, lower ramus half of upper ramus
Setal types	2

Female pleopods : (Fig. 2f, g, h, j)

Number	: 4
Nature	: Biramous, lower ramus in 1 equals upper ramus, in 2 and 3 3/4 of upper ramus and in 4 more than half of upper ramus
Setal types	: 1-3 with types 1 and 3 and 4 with type 2.

Colour :

In live specimens, the carapace and legs are red in colour. Eyestalk has black stripes. Yellow longitudinal stripes are present on the walking legs. The tergal plates of the abdomen are also brightly coloured as the carapace. Formalin-preserved specimens appear yellow or orange.

Distribution :

West and South East coast of Africa, Bay of Bengal, Penang, Singapore, Gaspar Strait, Borneo and Hong Kong.

Remarks :

This is the largest hermit crab occurring in Porto Novo waters and is very common in the trawl catches from local inshore waters. Fairly big sized specimens were collected from the shells of *Xancus pyrum*, *Hemifusus pugilinus* and *Rapana bulbosa*. Sea anemones were found on most of shells inhabited by this animal.

***Clibanarius infraspinatus* Hilgendorf (Fig. 3)**

1869. *Clibanarius infraspinatus* Hilgendorf, V. D. Decken's Reisen Ost. Afr. : 97.

1905. *Clibanarius infraspinatus* : Alcock, Cat. Indian Mus. Crust., : 44.

Material :

50 specimens (23 males and 27 females) ranging in size from 5 mm to 27 mm (carapace length) collected from Vellar estuary were examined.

Sexual dimorphism :

Male pleopods : (Fig. 3b, c, d, e)

- Number : 4
 Nature : Biramous, lower ramus about half of upper ramus
 Setal type : 2

Female pleopods : (Fig. 3f, g, h, j)

- Number : 4
 Nature : Biramous, lower ramus in 1 equals upper ramous, in 2 and 3 about 3/4 of upper ramus and in 4 about half of upper ramus
 Setal types : 1-3 with all the 3 types and 4 with type 2 only

Colour :

When alive the carapace is yellowish green. The distal ends of chelipeds and other legs are yellow in colour. The eyestalks are almost entirely covered by brown stripes. In formalin preserved specimens the carapace is brownish pink and cheliped, pereopeds eyestalk and antennal acicle are reddish brown. The yellow stripes on second and third legs appear red.

Distribution :

Red Sea, Arabian Sea, Bay of Bengal, Singapore, Tavoy, Philippines, Sydney and Taiwan.

Remarks :

This fairly big sized estuarine hermit crab is found in sandy substrates in the marine zone of the Vellar estuary. This species was found to occupy the shells of 15 species of gastropods. While the other estuarine forms occur very commonly in the intertidal area, this species could be collectd only during certain seasons of the year.

***Clibanarius padavensis* De Man (Fig. 4)**

1893. *Clibanarius padavensis* De Man, *J. Linn. Soc.*, : 242.

1905. *Clibanarius padavensis* : Alcock, *Cat. Indian Mus. Crust.*, : 44.

Material :

40 specimens (22 males and 18 females) ranging in size from 4 mm to 20 mm (carapace length) collected from Vellar estuary were examined.

Sextual dimorphism :**Male pleopods :** (Fig. 4b, c, d, e)

- Number : 4

Nature : Biramous, lower ramus less than half of upper ramus

Setal type : 2

Female pleopods : (Fig. 4f, g, h, j)

Number : 4

Nature : Biramous, lower ramus in 1 equals upper ramus, in 2 about 3/4, in 3 more than half and in 4 about half of upper ramus

Setal types : 1-3 with types 1 and 3 and 4 with type 2

Colour :

When alive, body is yellowish green. Three longitudinal crimson coloured stripes are present, one on the dorsal side and two on the lateral sides of the eyestalks. When viewed from above the corneal peninsula is very distinct and white in colour. Crimson coloured longitudinal stripes are also present on all the pereopods, very distinct on walking legs and on antennal peduncles. Formalin preserved specimens are yellow in colour and the stripes become red in colour.

Distribution :

East Coast of Africa from Delagoa Bay northwards and Madagascar, West Coast of India, Bay of Bengal, Singapore and East Indies to Australia.

Remarks :

This common estuarine hermit crab occurs abundantly in the sandy areas of the Vellar estuary and is found along with *C. longitarsus*, *C. olivaceus*, *C. insfraspinatus* and *Diogenes avarus*, inhabiting a wide variety of gastropod shells (47 species).

***Clibanarius olivaceus* Henderson (Fig. 5)**

1915. *Clibanarius olivaceus* Henderson, *Rec. Indian Mus.*, 11 : 26.

1935. *Clibanarius olivaceus* : Reddi, *Curr. Sci.*, 3 : 561

1941 *Clibanarius olivaceus* : Gravely, *Bull. Madras Govt. Mus.*, (n. s.) *nat. hist.*, 5(1) : 77.

Material :

Large number of specimens ranging in size from 3.5 mm to 10.0 mm (carapace length) collected from the Vellar estuary were examined.

Sexual dimorphism :

Male pleopods : (Fig. 5b, c, d, e)

- Number : 4
 Nature : Biramous, lower ramus less than or
 about half of upper ramus
 Setal Type : 2

Female pleopods : (Fig. 5f, g, h, j)

- Number : 4
 Nature : Biramous, lower ramus in 1-3 more than
 or about half of upper ramus in
 4 less than half of upper ramus
 Setal types : 1-3 with types 1, 2 and 3 and 4 with
 type 2

Colour :

In live condition, the carapace and legs are green in colour. Three red lines, one on the dorsal side and two on the lateral sides are present on eyestalks. On the merus and carpus of walking legs brownish dark spots are seen. Formalin preserved specimens are yellowish with the chelipeds and other legs red in colour.

Distribution :

Chilka lake, Ennur and Adaiyar backwaters of Madras, Vellar estuary, Porto Novo and Andaman Islands.

Remarks :

This is the most abundant hermit crab in Vellar estuary, especially in muddy areas. This tiny hermit crab was found to occupy the shells of 9 species of gastropods but was seen to occupy very commonly the shells of *Cerithidea fluviatilis*.

***Clibanarius longitarsus* (De Hann) (Fig.6)**

1849. *Pagurus longitarsus* De Hann, *Faun. Jap. Crust.*, : 211.
 1852. *Clibanarius longitarsis* : Dana, *U.S. Expl. Exped. Crust.*, : 464.
 1902. *Clibanarius longitarsus* : De Man, *Decapod und Stomatop.*, : 741
 1950. *Clibanarius longitarsis* : Barnard. *Ann. S. Afr. Mus.*, : 434.

Material :

Large number of specimens ranging in size from 4 mm to 33 mm (carapace length) collected from Vellar estuary, were examined.

Sexual dimorphism :

Male pleopods : (Fig.6b, c, d, e)

- Number : 4
 Nature : Biramous, lower ramus about half of upper
 ramus

Setal type : 2

Female pleopods : (Fig. 6f, g, h, j)

Number : 4

Nature : Biramous, lower ramus in 1-3 slightly shorter than upper ramus, in 4 about half of upper ramus

Setal types : 1-3 with types 1,2 and 3,4 with type 2

Colour :

When alive this backwater species is olive green in colour. Eyestalk without stripes and yellow in colour. Blue longitudinal stripes can be seen on antennal peduncles and on walking legs. Formalin preserved specimens are yellow in colour. The blue stripes on walking legs appear faded and the corneous pads on the fourth and fifth legs become red

Distribution :

From East coast of Africa throughout Indo-Pacific to Philippine Islands and Japan.

Remarks :

This shirly big sized estuarine hermit crab occurs abundantly in the Vellar estucrs and it was found to occupy as many as 72 species of gastroped shells.

General discussion :

Colour is a reliable character in separating species of *Clibanarius* occurring in Port Novo waters. Among the five species of *Clibanarius* represented here, *C. infraspinatus*, *C. padavensis*, *C. olivaceus* and *C. longitarsus* are estuarine and *C. clibanarius* is marine. While all the estuarine species appear dull, the marine species is brightly coloured and thus it can be readily distinguished from others in live condition.

In formalin preserved specimens, the key is helpful in distinguishing three species (*C. clibanarius*, *C. infraspinatus* and *C. olivaceus*). In the other two species eventhough the hand is rough with spinules the following characters are helpful in distinguishing them: In *C. longiitarsus* the eyestalks are only a little longer than the anterior border of carapace, whereas in *C. padavensis* eyestalks are much longer than the anterior border of carapace. In *C. longitarsus*, the dactylus of both the second and third legs are always longer than the propodus whereas in *C. padavensis* the dactylus of third leg alone is longer than the propodus.

Genus *Dardanus* Paulson

1798. *Pagurus* Fabricius, *Entomolygia Systemetica*, Suppl., : 411
 1952. *Pagurus* Dana, *Proc. Acad. Nat. Sci. Philad.*, : 449.
 1875. *Dardanus* Paulson, (Isreal program for Scientific Translations, 1961).
 1903. *Dardanus* : Rathbun Mary, *Proc. U. S. Nat. Mus.*, : 33.

This genus is represented by three species in Porto Novo waters.

Key for the identification of Dardanus species :

1. Eystalks as long as antennular peduncles, left cheliped much larger than right ; outer face of propodus and dactylus of third left leg with transverse squamiform markings *setifer*
2. Eystalks shorter than antennular peduncles.
 - A. Left cheliped larger than right, outer face of left hand closely covered with imbricating scale-like tubercles. *imbricatus*
 - B. Both chelipeds equal and similar, cornea greatly dilated and flattened *hessi*

Dardanus setifer (Milne Edwards) (Fig. 7)

1836. *Pagurus setifer* Milne Edwards, *Ann. Sci. Nat. Zool.*, : 274.
 1859. *Pagurus sculptiles* : Stimpson, *Proc. Acad. Nat. ci. Philad.*, : 246
 1878. *Pagurus pavimentatus* : Hilgendorf, *MB. K. Akad. Berlino.*, : 816
 1905. *Pagurus setifer* : Alcock, *Cat. Indian Mus. Crust.*, : 83
 1956. *Dardanus setifer* : Gordon, *Amer. Mus. Natur Hist. Bull.*, : 316

Material :

Large number of specimens ranging in carapace length from 15 mm to 24 mm collected from the trawl catches from local inshore waters were examined.

Sexual dimorphism :

Male pleopods : (Fig. 7b, c, d, e)

- Number : 4
 Nature : Biramous
 Setal type : 2

Female pleopods : (Fig. 7f, g, h, j)

- Number : 4
 Nature : 1-3 triramous and 4 biramous but

lower ramus bifurcated distally
sometimes

Setal types : 1-3 with types 1 and 3 and 4 with
type 2

Colour :

When alive the specimens are cream coloured with red patches. The dactylus and propodus of second left leg distinctly red in colour. In formalin preserved specimens, the above colourations could be noticed even after one year.

Distribution :

East coast of Africa, Madagascar, India, Ceylon and throughout the Indo-Pacific region to Australia and Hong Kong.

Remarks :

This is very common in the trawl catches from the muddy shores. This has been found to inhabit the shells of 6 species of gastropods.

***Dardanus imbricatus* (Milne Edwards) (Fig. 8)**

1848. *Pagurus imbricatus* Milne Edwards, *Ann. Sci. Nat. Zool.*, : 61.

1888. *Pagurus imbricatus* : Henderson, *Challenger Anomura*, : 57.

1905. *Pagurus imbricatus* : Alcock, *Cat. Indian Mus. Crust.*, : 92.

1973. *Dardanus imbricatus* : Witherington, *Ph. D. diss., V. I. M. S.*, : 39.

Material :

Only one female specimen could be collected presently. The length of the carapace was 14.5 mm.

Sexual dimorphism :

Female pleopods : (Fig. 8f, g, h, j)

Number : 4

Nature : 1-3 triramous, 4 biramous

Setal types : 1-3 with types 1 and 3 and 4
with type 2.

Colour :

In live condition it is cream coloured with a few scattered pinkish dots on the legs and eyestalks. In formalin preserved specimen the colour fades slightly and the distal ends of cheliped and legs become reddish, the squamiform tubercles are quite evident on the left palm, propodus and dactylus of third left leg.

Distribution :

Bay of Bengal, Ceylon, Indonesia, Australia and New Zealand.

Remarks :

This fairly deep water form could only be collected once.

Dardanus hessi (Miers) (Fig. 9)

1884. *Pagurus hessi* Miers, *Zool. H. M. S. Alert*, : 185.

1888. *Pagurus similimanus* : Henderson, *Challenger Anomura*, : 59.

1905. *Pagurus hessi* : Alcock, *Cat. Indian Mus. Crust.*, : 93.

1956. *Dardanus hessi* : Gordon, *Amer. Mus., Natur. Hist. Bull.*, : 314.

Material :

50 specimens (27 males and 23 females) collected from the trawl catches of local inshore waters were examined. The carapace length of the specimens examined varied between 12 mm to 28 mm.

Sexual dimorphism :**Male pleopods :** (Fig. 9b, c, d, e)

- Number : 4
 Nature : Biramous
 Setal types - Upper ramus with type 2, lower ramus with few type 3

Female pleopods : (Fig. 9f, g, h, j)

- Number : 4
 Nature : 1-3 triramous, 4 biramous but lower ramus bifurcated distally
 Setal types : 1-3 with types 1 and 3 and 4 similar to males

Colour :

When alive the carapace and legs are cream coloured with red patches. The dactylus of walking legs, the fingers and distal part of the palm of cheliped are brick red in colour. In formalin preserved specimens the same colouration was noticed even after one year.

Distribution :

Gulf of Oman, Coasts of India, Thailand, Indonesia throughout the Celebes Sea and Arafura sea,

Remarks :

This fairly big sized hermit crab is very common in the trawl catches of local inshore waters. It has been observed to occupy the shells of 8 species of gastropods. Sea anemones were often found attached to the shells inhabited by this animal.

Genus Diogenes Dana

1852. *Diogenes* Dana, *U. S. Expl. Exped. Crust.*, : 438

1893. *Diogenes* : Stebbing, *Hist. Crust.*, : 160

1905. *Diogenes* : Alcock, *Cat. Indian. Mus. Crust.*, : 59

This genus is represented in Porto Novo waters by 8 species.

Key for the identification of Diogenes species :

- 1 Rostriform process denticulate, with free edge spinose, at least distally
 - A. Carapace longer than broad :
 - i) Antennal acicle bifurcate, inner shorter branch reaches base of terminal joint of peduncle ; outer surface of left hand beset with conical tubercles, each of which carries a wreath of short stiff radiating setae *merguiensis*
 - ii) Antennal acicle bifurcate, inner branch reaches about half way along penultimate joint of peduncle
 - a) Outer face of major chela spinose *diogenes*
 - b) Outer face of major chela closely and finely granulose *custos*
 - iii) Antennal acicle obscurely bifurcate, outer branch does not reach base of terminal joint of peduncle ; outer surface of left hand closely and finely granulous, length of major chela equalling width *planimanus*
 - B. Carapace broader than long *miles*
2. Rostrum a slender, non-serrated, simple spinule
 - A) Fixed finger of left cheliped deflexed
 - i) Eyestalks extending beyond base of terminal joint of antennular peduncle, wrist and hand of left cheliped remarkably elongate *avarus*
 - ii) Eyestalks hardly reach base of terminal joint of antennular

peduncle ; a single obliquely longitudinal crest on outer surface of left palm	---	<i>costatus</i>
B). Fixed finger of left cheliped not deflexed ; a single longitudinal row of spinules on upper part of outer surface of left palm, antennal peduncle shorter than antennular peduncle	<i>rectimanus</i>

Diogenes merguensis De man (Fig. 10)

1888. *Diogenes merguensis* De man, *Journ. Linn. Soc. Zool.*, XXii : 228.

1836. *Diogenes miles* : Milne Edwards, *Ann. Sci. Nat. Zool.*, Vi : 284.

1852. *Diogenes miles* : Dana, *U. S. Expl. Exp. Crust.*, : 439

1905. *Diogenes merguensis* : Alcock, *Cat. Ind. Mus. Crust.*, : 63.

Material :

50 specimens (24 males and 26 females) ranging in size from 11 mm to 26 mm (carapace length) collected from the trawl catches from local inshore waters were examined in the present study.

Sexual dimorphism :

Male pleopods : (Fig. 10b, c, d, e)

Number	: 4
Nature	: Uniramous
Setal types	: 2

Female pleopods : (Fig. 10f, g, h, j)

Number	: 4
Nature	: Biramous
Setal types	: 1-3 with types 1, 2 and 3, 4 with type 2

Colour :

In live specimens, the carapace is pinkish in colour. Cheliped and legs are also pinkish in colour but distal end of propodus of walking legs is yellow in colour. The chela is interspersed with yellow and pink. Four red stripes, two on the dorsal side and two on the ventral side are seen on eyestalks. Fine longitudinal red stripe is also seen on antennular peduncle.

Distribution :

Bay of Bengal and Indo-China

Remarks :

This fairly big sized marine hermit crab is very common in local

inshore waters. They are found to occupy wide mouthed gastropod shells like *Babylonia spirata* and *Rapana bulbosa*.

Diogenes diogenes (Herbst) (Fig. 11)

1791. *Cancer diogenes* Herbst, *Krabben* : 17.

1798. *Pagurus miles* : Fabricius, *Ent. Syst. Suppl.*, : 412

1893. *Diogenes diogenes* : Henderson, *Trans. Linn. Soc. Zool.*, : 412.

1905. *Diogenes diogenes* : Alcock, *Cat. Indian. Mus. Crust.*, : 62.

Material :

60 specimens (33 males and 27 females) ranging in carapace length from 15 mm to 29 mm, collected from the trawl catches of local inshore waters were examined in the present study.

Sexual dimorphism :

Male pleopods : (Fig. 11 b, c, d, e)

- Number : 4
- Nature : Uniramous
- Setal Type : 2

Male pleopods : (Fig. 11 f, g, h, j)

- Number : 4
- Nature : 1-3 biramous and 4 uniramous
- Setal types : 1-3 with types 1 and 3, 4 with type 2

Colour :

Chelipeds, legs and abdomen are light cream coloured. A pinkish longitudinal band is seen on the eyestalk. The above colourations could be seen even after one year in formalin preserved specimens.

Distribution :

West and East coasts of India, East coast of Africa southward to Mozambique and Madagascar.

Remarks :

This fairly big sized marine form is quite common in the trawl catches from local inshore waters. This species was found to occupy the shells of 20 species of gastropods. A polychaete worm *Gattyana* sp. was found to live inside the shell on which sea anemones were found to inhabit.

Diogenes custos (Fig. 12)

1798. *Pagurus custos* Fabricius, *Ent. Syst. Suppl.*, : 412.

1893. *Diogenes custos* : Henderson, *Trans. Linn. Soc. Zool.* : 414.

1905. *Diogenes custos*: Alcock, *Cat. Indian. Mus. Crust.*, : 64.

Material :

Only three specimens (2 males and 1 female) were collected from the trawl catches of local inshore waters and examined.

Sexual dimorphism : (Fig. 12b, c, d, e)

Male pleopods :

Number : 4
Nature : uniramous
Setal type : 2

Female pleopods : (Fig. 12f, g, h, j)

Number : 4
Nature : 1-3 biramous, 4 uniramous
Setal type 1-3 with types 1, 2 and 3, 4 with type 2

Colour :

Just like *D. diogenes*, live specimens are cream coloured. Formalin preserved specimens are brownish.

Distribution

Arabian Sea, Bay of Bengal, Andaman, Megui and South East coast, of Australia.

Remarks :

This form rarely occurred in the trawl catches, Collected from shells of *Babylonia spirata* and *Ficus ficus* which were encrusted with sea anemones and barnacles.

***Diogenes planimanus* Henderson (Fig. 13)**

1893. *Diogenes planimanus* Henderson, *Trans. Linn. Soc. Zool.*, : 416.

1906. *Diogenes custos* var *planimanus* : Alcock, *Cat. Indian. Mus. Crust.* 66.

1969. *Diogenes planimanus* : Thomas, *C.M.F.R.I. Bull.*, 7 : 41.

Material :

50 specimens (25 males and 25 females) collected from the inter-tidal areas were examined.

Sexual dimorphism :

Male pleopods (Fig. 13b, c, d) :

Number : 4
Nature : Uniramous
Setal type : 2

Female pleopods : (Fig. 13f, g, h, j)

- Number : 4
 Nature : 1-3 biramous, 4 uniramous
 Setal type : 1-3 with types 1, 2 and 3, 4 with type 2

Colour

Carapace, cheliped and other legs are pinkish in colour. In formalin preserved specimens the above colourations have faded.

Distribution :

Bay of Bengal and Malayan Peninsula

Remarks :

This is the only marine hermit crab of Porto Novo which occurred in the intertidal area of the open beach. This species was found to occupy the shells of 11 species of gastropods.

Diogenes miles (Herbst) (Fig. 14)

1791. *Cancer miles* Herbst, *Krabben*, : 19.

1893. *Diogenes miles* : Henderson, *Trans. Linn. Soc. Zool.*, : 413.

1905. *Diogenes miles* : Alcock, *Cat. Indian, Mus. Crust.*, : 67.

Material :

Only five specimens (2 males and 3 females) were collected presently and examined.

Sexual dimorphism :**Male pleopods** : (Fig. 14b, c, d, e)

- Number : 4
 Nature : Uniramous
 Setal type : 2

Female pleopods : (Fig. 14f, g, h, j)

- Number : 4
 Nature : Biramous
 Setal types : 1-3 with types 1 and 3, 4 with type 2

Colour :

Carapace and legs are yellow with ash coloured patches. Ash coloured longitudinal stripe is also seen on the eyestalks. Formalin preserved specimens are uniformly yellow in colour.

Distribution :

India.

Remarks :

All the five specimens were noted to occupy the shells of *Oliva gibbosa*. This is the only marine species which has successfully colonised this particular species of shell in Indian waters. A very fine example for adaptive radiation, this animal has flattened its carapace for inhabiting this particular gastropod shell where the opercular opening is flattened. Other hermit crabs cannot even enter this shell. About 14 species of hermit crabs are known to occur in the inshore waters of Porto Novo and naturally there will be heavy competition among them for the occupation of empty gastropod shells. Shell and habitat selections are the two mechanisms which enable many species of hermit crabs to co-exist. *Diogenes miles* is a typical example for resource partitioning and other hermit crabs do not compete with this for the occupation of narrow mouthed shells; this mechanism thus enables this hermit crab to co-exist with other hermit crabs amicably in the marine environment.

Diogenes avarus Heller (Fig. 15)

1865. *Diogenes avarus* Heller, *Novara crust.*, : 83.

1887. *Diogenes avarus* Walker, *J. Linn. Soc. Zool.*, : 113.

1905. *Diogenes avarus* Alcock, *Cat. Indian Mus. Crust.*, : 68

Material :

Large number of specimens ranging in size from (carapace length) 4mm to 10mm were examined.

Sexual dimorphism :**Male pleopods :** (Fig: 15b, c, d, e)

Number : 4
Nature : Uniramous
Setal type : 2

Female pleopods (Fig. 15f, g, h, j)

Number : 4
Nature : 1-3 biramous, 4 uniramous
Setal types : 1-3 with types 1 2 and 3, 4 with type 2

Colour :

When alive the colour of the body is dull. Black transverse bands are seen on the walking legs and on the eyestalk. In formalin preserved specimens the carapace and the pereopods appear red in colour.

Distribution :

East Africa, Persian Gulf, Arabian Sea, Bay of Bengal, Singapore, Torres Strait and Philippines.

Remarks :

This tiny hermit crab is very common in the sandy substrates of Vellar estuary. Found to occupy the shells of *Cerithidea fluviatilis* and *Umbonium vestiarium*, it can be easily located due to its lopsided movements. During noon and at other times when the sun is blazing hot and the temperature of the water is high, it buries into the sand. In the mornings and evenings, when it is cooler, they move about freely.

Diogenes costatus Henderson (Fig. 16)

1893. *Diogenes costatus* Henderson, *Trans. Linn. Soc. Zool.*, : 416.

1905. *Diogenes costatus* Alcock, *Cat. Indian Mus. Crust.*, : 67.

Material :

50 specimens (25 males and 25 females) collected from the trawl catches of the local inshore waters were examined.

Sexual dimorphism :***Male pleopods :*** (Fig. 16b, c, d, e)

- Number : 4
Nature : Uniramous
Setal type : 2

Female pleopods : (Fig. 16f, g, h, j)

- Number : 4
Nature : Biramous/3 biramous and 1 uniramous
Setal type : 1-3 with types 1, 2 and 3, 4 with type 2

Colour

The body is cream coloured with pinkish patches on the carapace and legs. In formalin preserved specimens the pinkish patches appear faded.

Distribution

East coast of India,

Remarks :

This small hermit crab is very common in the trawl catches of local inshore waters. It was found to occupy the shells of 10 species of gastropods.

Diogenes rectimanus Miers (Fig. 17)

1884. *Diogenes rectimanus* Miers, *Zool., H. M. S. Alert.*, : 262.

1893. *Diogenes rectimanus* Henderson, *Trans. Linn. Soc. Zool.*, : 419.

1905. *Diogenes rectimanus* : Alcock, *Cat. Indian. Mus. Crust.*, : 71.

Material :

50 specimens (25 males and 25 females) collected from the trawl catches of local inshore waters were examined.

Sexual dimorphism :**Male pleopods :** (Fig. 17b, c, d, e)

Number : 4
Nature : Uniramous
Setal types : 2

Female pleopods : (Fig. 17f, g, h, j)

Number : 4
Nature : 1-3 biramous and 4 uniramous
Setal types : 1-3 with types 1, 2 and 3, 4 with type 2

Colour :

Live specimens appear dull with ash coloured patches on the carapace, eyestalks and legs. The antennal flagellum is blue coloured. In formalin preserved specimens the ash coloured patches turn pinkish red in colour, blue colour of the antennal flagellum fades.

Distribution :

Bay of Bengal

Remarks :

This small hermit crab is quite abundant in the trawl catches of local inshore waters. They were collected from the shells of 26 species of gastropods. The shells inhabited by this animal were often encrusted with sea anemones and barnacles. A polychaete worm, *Gattyana* sp. was found to live with this animal inside the shell.

Family COENOBITIDAE

The Coenobitidae are land hermit crabs the females of which visit the sea periodically to hatch off their eggs. It includes only two genera *Coenobita* and *Birgus*. In *Coenobita* the abdomen is soft, spirally coiled and asymmetrical. But in *Birgus* the abdomen is symmetrical, simply flexed, and is dorsally protected by large, overlapping, strongly calcified

tergum. In Porto Novo, this family is represented by a single species of *Coenobita*.

Genus : *Coenobita* Latreille

1826. *Coenobita* Latreille, *Fam. Nat. du R'egne Anim.*, : 276.

1837. *Coenobita* Milne Edwards, *Hist. Nat. Crust.*, 11 : 238.

1905. *Coenobita* Alcock, *Cat. Indian Mus. Crust.* : 140.

This genus is represented by a single species in Porto Novo waters.

***Coenobita cavipes* Stimpson (Fig. 18)**

1858. *Coenobita cavipes* Stimpson, *Proc. Acad. Nat. Sci. Philad.*, : 245.

1862. *Coenobita violascens* Heller, *Verh. Zool. Bot. Ges. Nien.*, XII : 524.

1892. *Coenobita compressus* Ortmann, *Zool. Jahrb. Syst.*, VI : 318.

1905. *Coenobita cavipes* Alcock, *Cat. Indian Mus. Crust.*, : 146.

Material :

55 specimens (30 males and 25 females) ranging in size from 4 mm to 34 mm (carapace length) collected from the banks of Vellar estuary were examined.

Sexual dimorphism :

Male pleopods : absent

Female pleopods : (Fig. 18f, g, h)

Number : 3

Nature : Biramous

Setal types : 1 and 3

Coxa of fifth leg :

Male : Spindle shaped (Fig. 18k)

Female : Squarish with forward projection and without backward projection (Fig. 18l).

Colour :

When alive the bigger specimens are violet in colour and small forms reddish. In medium sized animals both violet and red colour can be seen. Formalin preserved specimens are yellow in colour.

Distribution :

East coast of Africa, East coast of India, Andaman and Nicobars, Malaya and East Indies to Liu Kiu Islands to Solomon Islands.

Remarks :

This fairly big sized nocturnal land hermit crab occurs abundantly on

the banks of Vellar estuary. They were found to occupy the shells of twenty one species of gastropods. The bigger crabs were usually found to have outgrown their domicile shells.

Superfamily : PAGUROIDEA

Family : PAGURIDAE

Key to the genera of family Paguridae :

Gonopores simple ; vas deferens not produced ; right cheliped longer and bigger than left	<i>Pagurus</i>
Gonopores not simple, left vas deferens produced and strongly coiled into a spiral ; chelipeds similar and subequal		...	<i>Spiropagurus</i>

Genus *Pagurus* Fabricius

1775. *Pagurus* Fabricius, *Entomologia Systematica*, supplement ; 411.

1851. *Eupagurus* Brandt, *Middendorff's Reise in Sibiriens, Zool.*, : 105.

1852. *Bernhardus* Dana, *U. S. Expl. Crust.*, : 440

1905. *Eupagurus* Alcock, *Cat. Indian Mus. Crust.*, : 122

1961. *Pagurus* Sankolli, *J. Zool. Soc. India*, : 136.

In Porto Novo this genus is represented by a single species.

Pagurus carpofoaminatus (Alcock) (Fig. 19)

1905 *Eupagurus carpofoaminatus* Alcock, *Cat. Indian Mus. Crust.*, : 130.

1968. *Pagurus carpofoaminatus* Sarojini and Nagabhushanam, *Rec. Zool. Surv. India*, 66 : 271

Material :

Only six specimens (2 males and 4 females) were collected from the trawl catches of local inshore waters and examined.

Sexual dimorphism :

Male pleopods : (Fig. 19b, c, d)

Number	: 3
Nature	: Biramous
Setal type	2

Female pleopods : (Fig. 19f, g, h, j)

Number	4
Nature	: Biramous
Setal type	1-3 with types 3 and 2, 4 with type 2

Colour :

When alive, they are light brown in colour and formalin preserved specimens appear yellow.

Distribution :

Bay of Bengal, Malabar coast and Ceylon.

Remarks :

This fairly deep water species could be only rarely found in the trawl catches of local inshore waters. They were seen to live in the shells of *Nassa dorsata*.

Genus Spiropagurus Stimpson

1859. *Spiropagurus* Stimpson, *Proc. Acad. Nat. Sci. Philad.*, : 236

1905. *Spiropagurus* Alcock, *Cat. Indian Mus. Crust.*, : 117

This genus is represented by a single species in Porto Novo waters.

***Spiropagurus spiriger* (De Haan) (Fig. 20)**

1849. *Pagurus spiriger* De Haan, *Faun. Japan Crust.*, : 206

1858. *Spiropagurus spiriger* Stimpson, *Proc. Acad. Nat. Sci. Philad.*, : 248

1905. *Spiropagurus spiriger* Alcock, *Cat. Indian Mus. Crust.*, : 118.

Material :

20 specimens (12 males and 8 females) collected from trawlcatches of Porto Novo waters were examined.

Sexual dimorphism**Male pleopods : (Fig. 20b, c, d)**

Number : 3
Nature : Uniramous
Setal type 2

Female pleopods (Fig. 20f, g, h, j)

Number : 4
Nature : 1-3 biramous, 4 uniramous
Setal type : 3

Colour

Live specimens are light brown in colour. Oviposited eggs on pleopods are violet in colour.

Distribution :

Gulf of Aden and Arabian sea to Philippine Islands and South China sea.

Remarks :

This fairly deep water form is very common in the trawl catches beyond 10 fathom line. Eventhough the carapace is flattened, it has been collected from wide mouthed gastropod shells belonging to 16 different species. The polychaete worm *Gattyana* sp. was found living with this animal inside the shell.

GENERAL REMARKS

Reddi (1935) reported the occurrence of 11 species of hermit crabs in Porto Novo waters of which 7 species could be collected in the present work besides 13 additional species reported for first time. However, four species viz. *Clibanarius arethusa*, *C. aequabilis*, *Pagurus punctulatus* and *Coenobita rugosus* reported by Reddi (1935) did not occur in the present collections.

In hermit crabs, males are generally bigger than females. Besides the genital opening which is on coxa of 5th in male and of 3rd in female, the structure of pleopods and their setation are also very helpful to differentiate between the sexes.

ACKNOWLEDGEMENTS

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SUMMARY

Twenty species of hermit crabs belonging to seven genera have been collected and reported presently from Porto Novo waters. Of these, fourteen species are marine, five estuarine and one terrestrial. Keys for identification of families, genera and species are given. Each species is also illustrated and notes on sexual dimorphism, colour and distribution are given.

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FIGURES

Fig. 1. *Paguristes longirostris* Dana

a.—Entire animal ; b, c, d,—I, II, III pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively ; k—ventral view of male fifth legs ; 1-ventral view of female fifth legs.

Fig. 2. *Clibanarius clibanarius* (Herbst)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

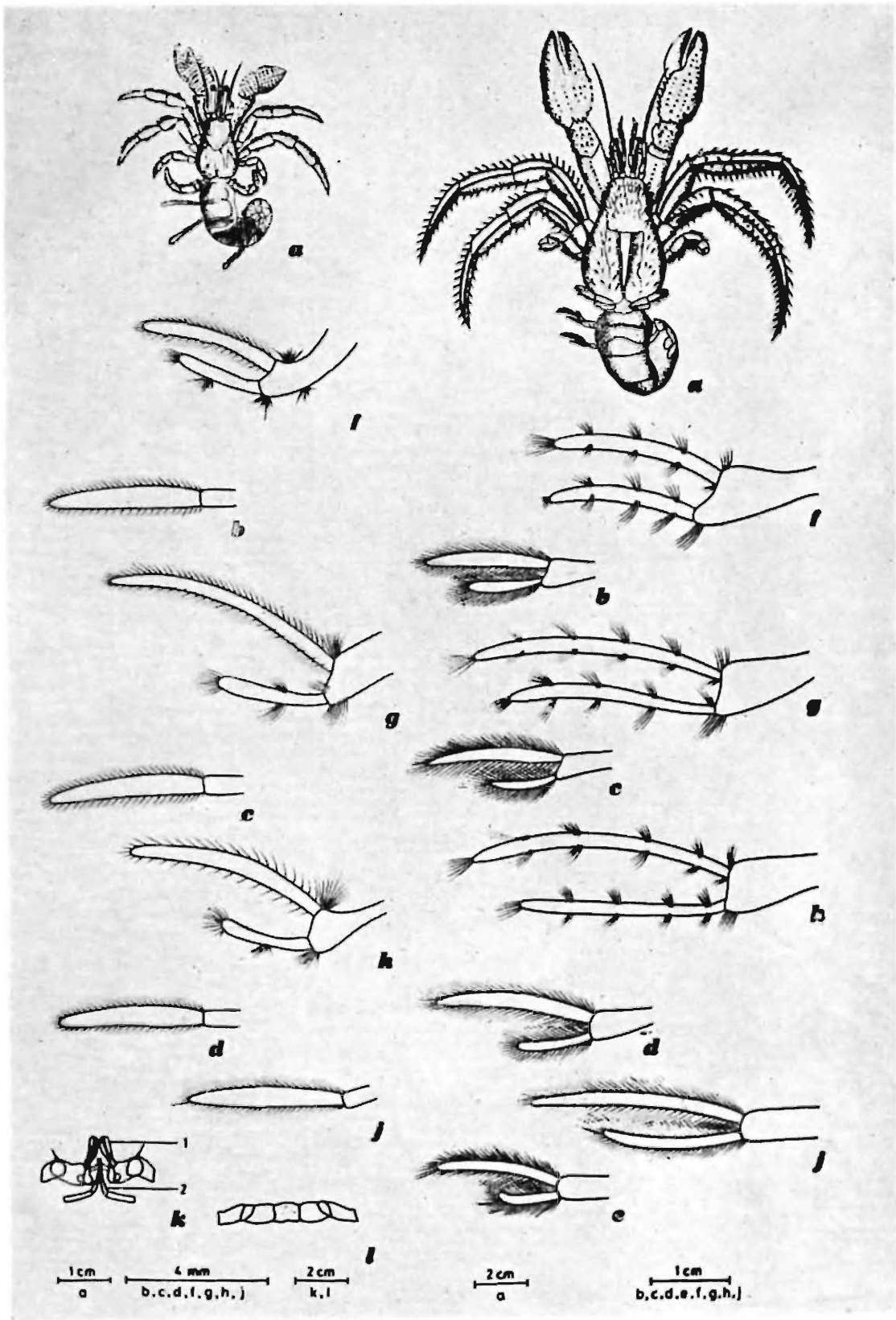


Fig. 1

Fig. 2

Fig. 3. *Clibanarius infraspinatus* Hilgendorf

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

Fig. 4. *Clibanarius padavensis* De Man

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, i—I, II, III, IV pleopods of females respectively.

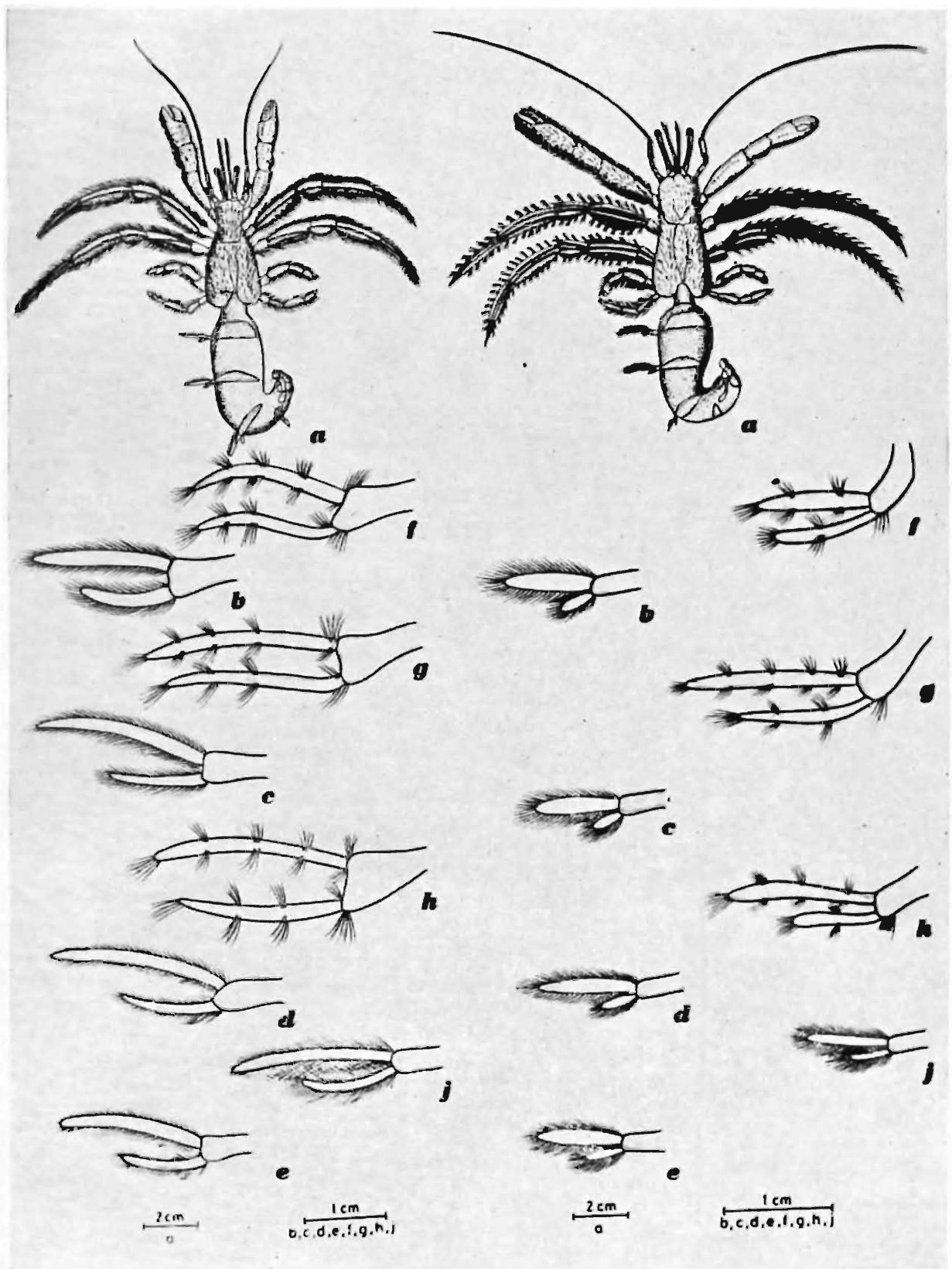


Fig. 3

Fig. 4

Fig. 5. *Clibanarius olivaceus* Henderson

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

Fig. 6. *Clibanarius longitarsus* (De Hann)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, i—I, II, III, IV pleopods of females respectively.

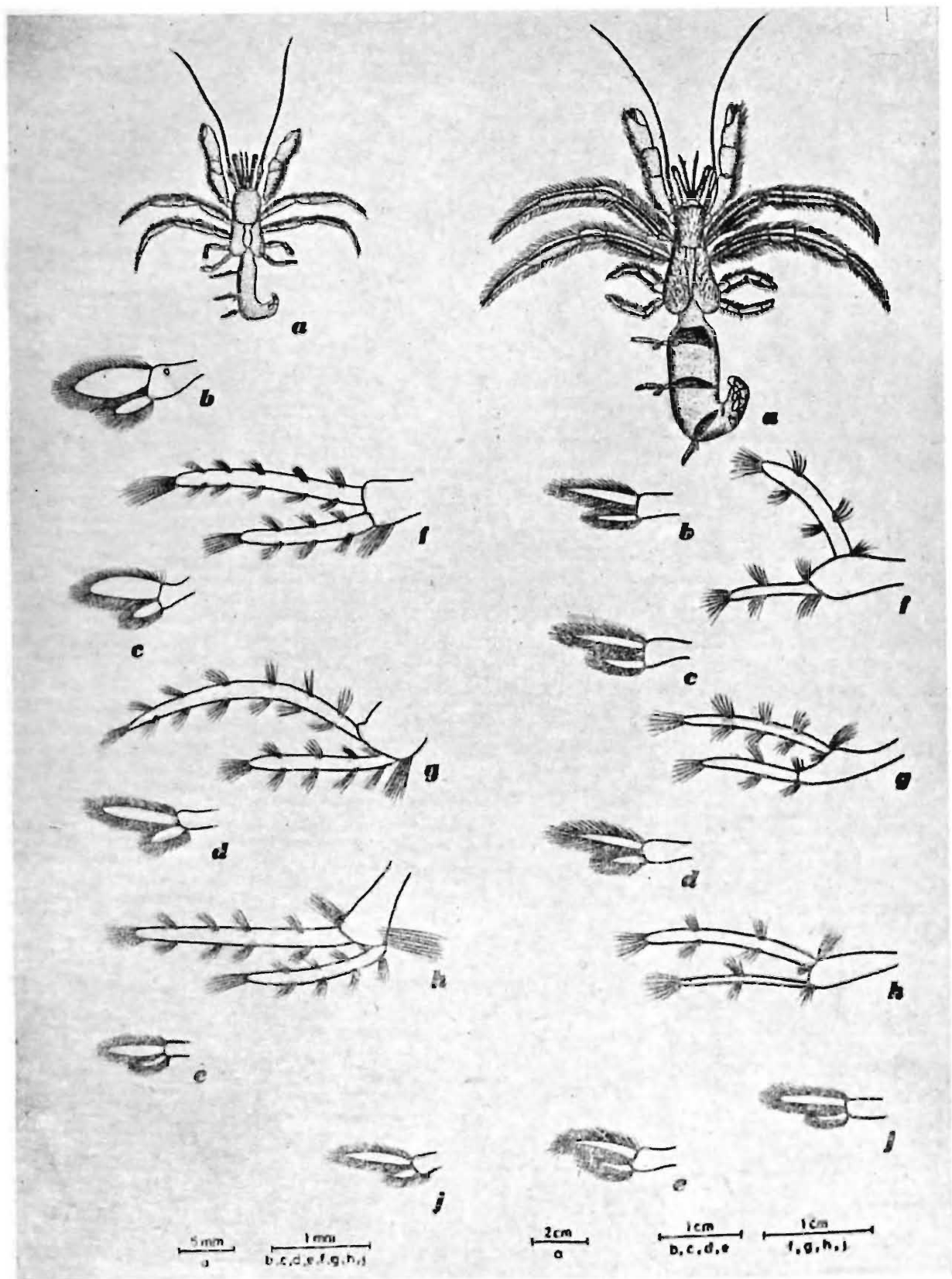


Fig. 5

Fig. 6

Fig. 7. *Dardanus setifer* (Milne Edwards)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

Fig. 8. *Dardanus imbricatus* (Milne Edwards)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, i—I, II, III, IV pleopods of females respectively.

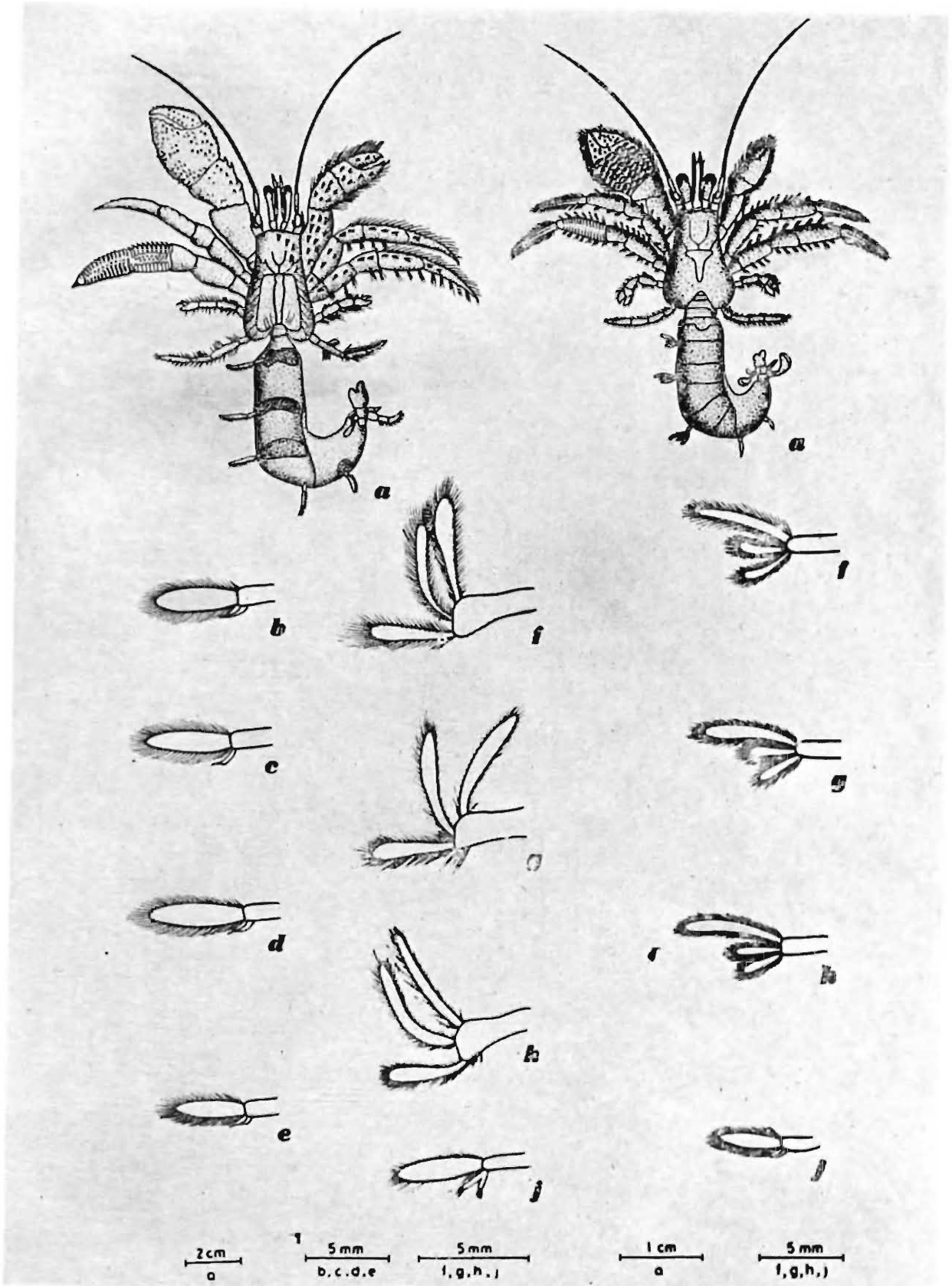


Fig. 7

Fig. 8

Fig. 9. *Dardanus hessi* (Miers)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

Fig. 10. *Diogenes marguiensis* De Man

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, i—I, II, III, IV pleopods of females respectively.

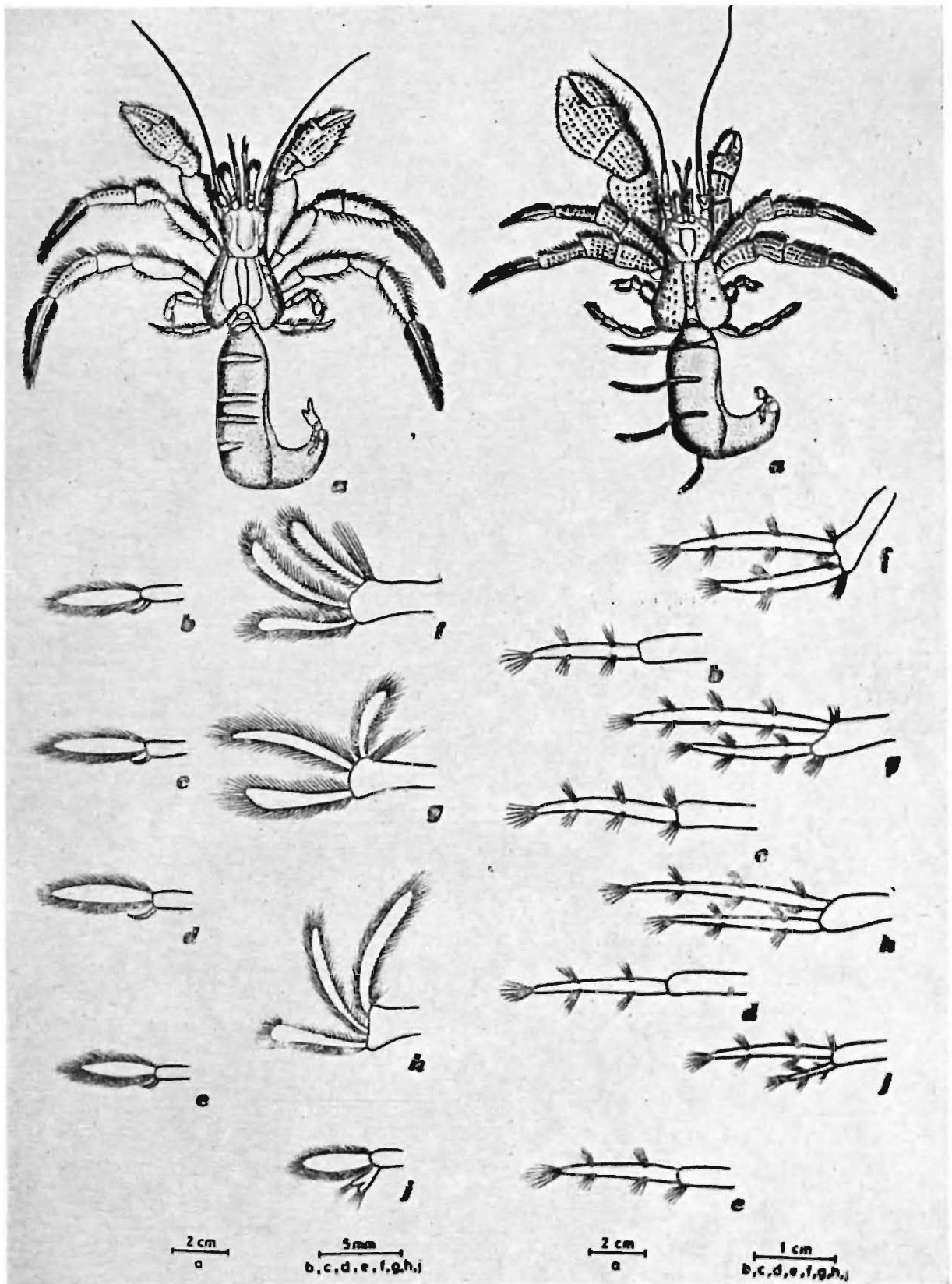


Fig. 9

Fig. 10

Fig. 11. *Diogenes diogenes* (Herbst)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

Fig. 12. *Diogenes custos* (Fabricius)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, i—I, II, III, IV pleopods of females respectively.

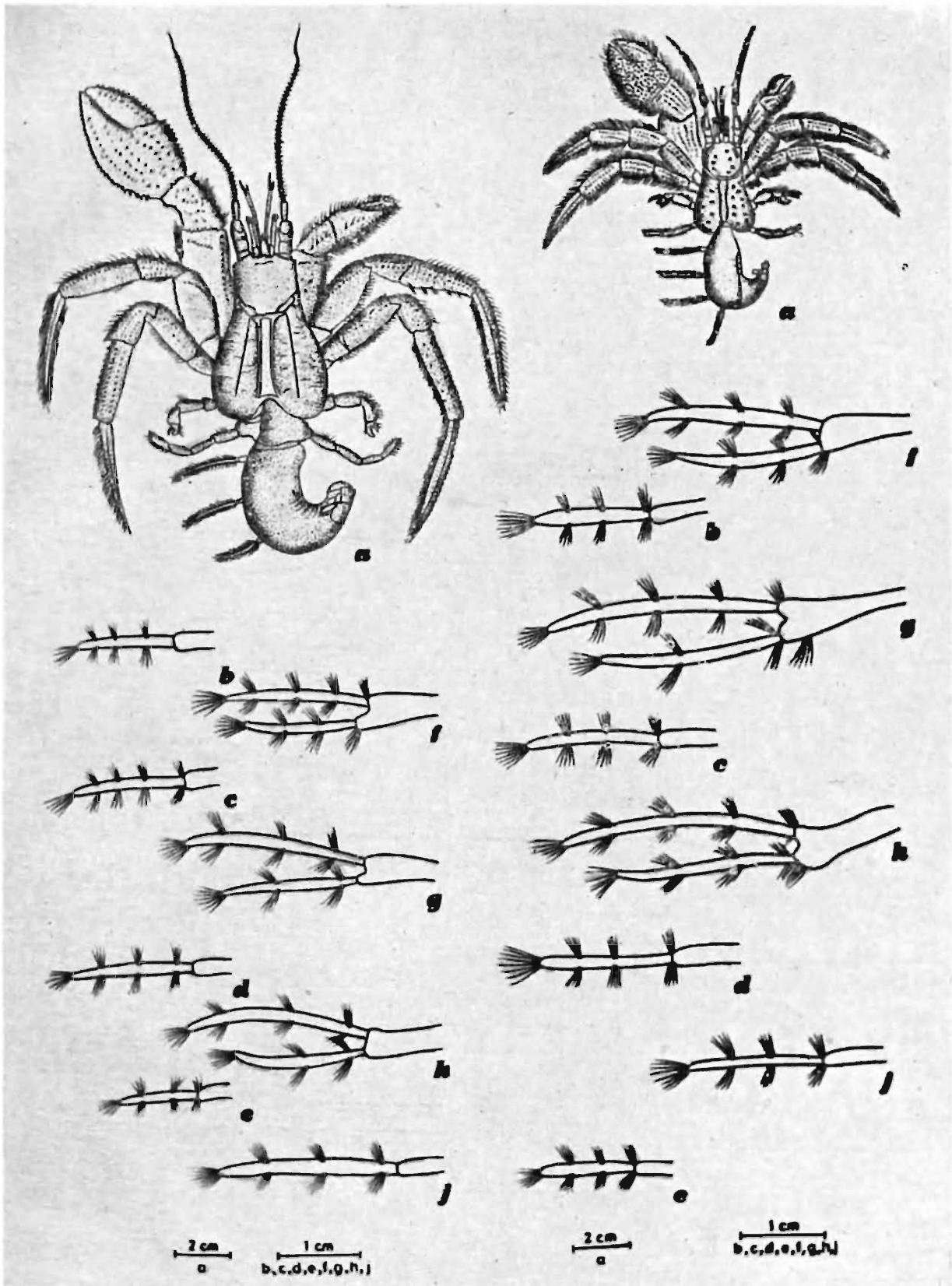


Fig. 11

Fig. 12

Fig. 13. *Diogenes planimanus* Henderson

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

Fig. 14. *Diogenes miles* (Herbst)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, i—I, II, III, IV pleopods of females respectively.

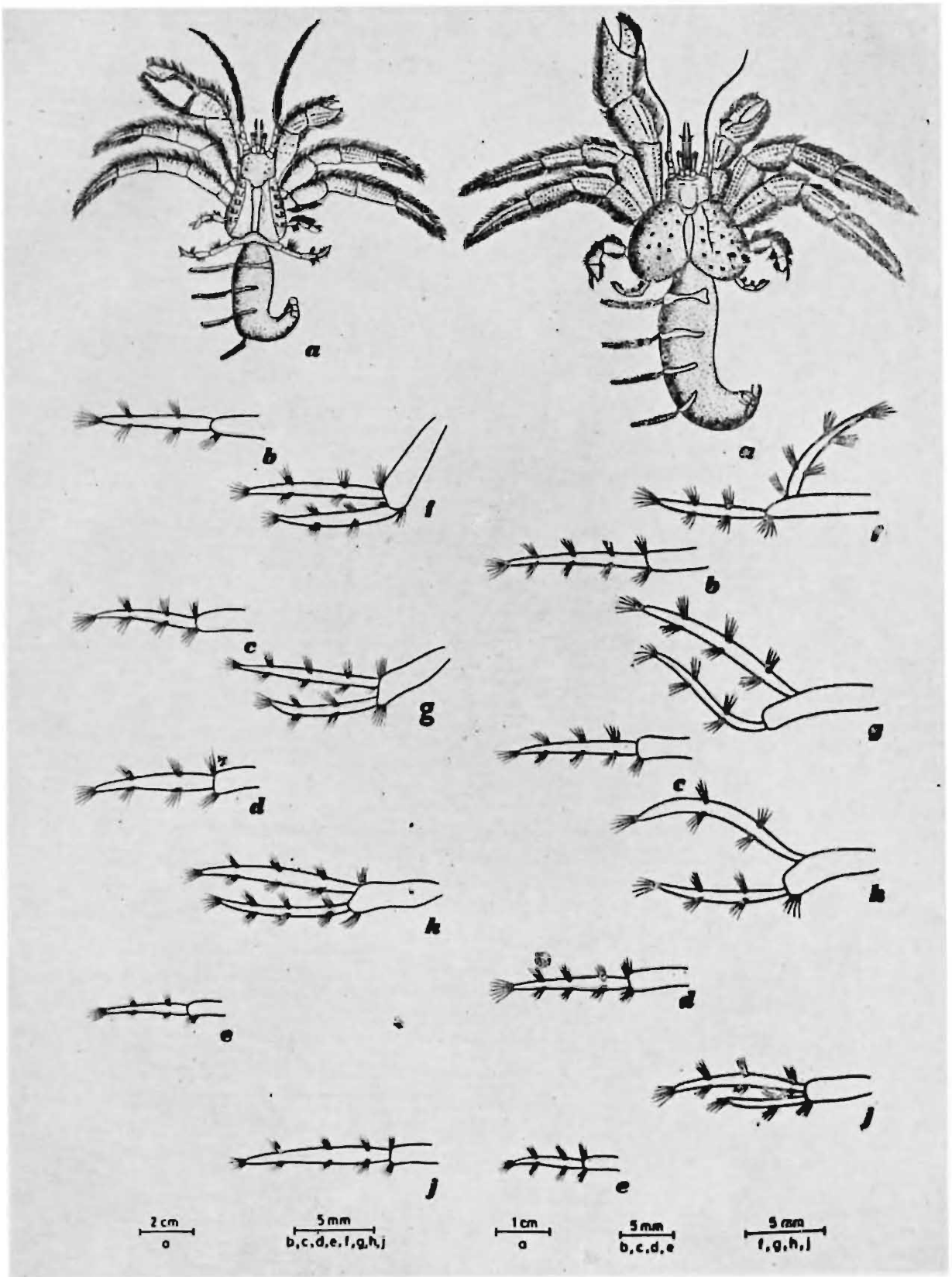


Fig. 13

Fig. 14

Fig. 15. *Diogenes avarus* Heller

a.—Entire animal ; b, c, d, e—l, II, III, IV pleopods of males respectively ; f, g, h, j—l, II, III, IV pleopods of females respectively.

Fig. 16. *Diogenes costatus* Henderson

a.—Entire animal ; b, c, d, e—l, II, III, IV pleopods of males respectively ; f, g, h, i—l, II, III, IV pleopods of females respectively.

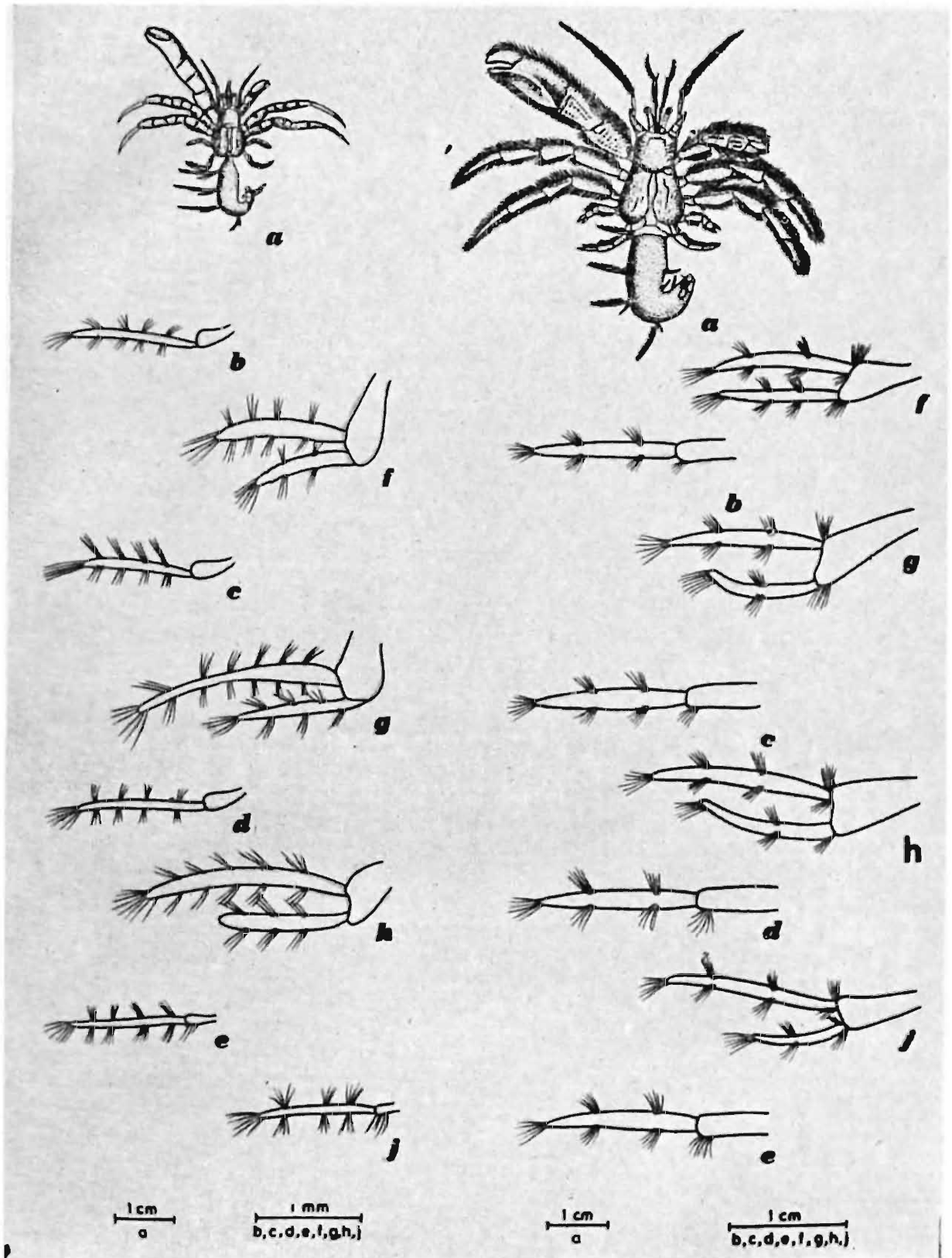


Fig. 15

Fig. 16

Fig. 17. *Diogenes rectimanus* Miers

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, i—I, II, III, IV pleopods of females respectively.

Fig. 18. *Coenobita cavipes* Stimpson

a.—Entire animal ; f, g, h—I, II, III pleopods of females respectively ; k—ventral view of male fifth legs ;
1—ventral view of female fifth legs.

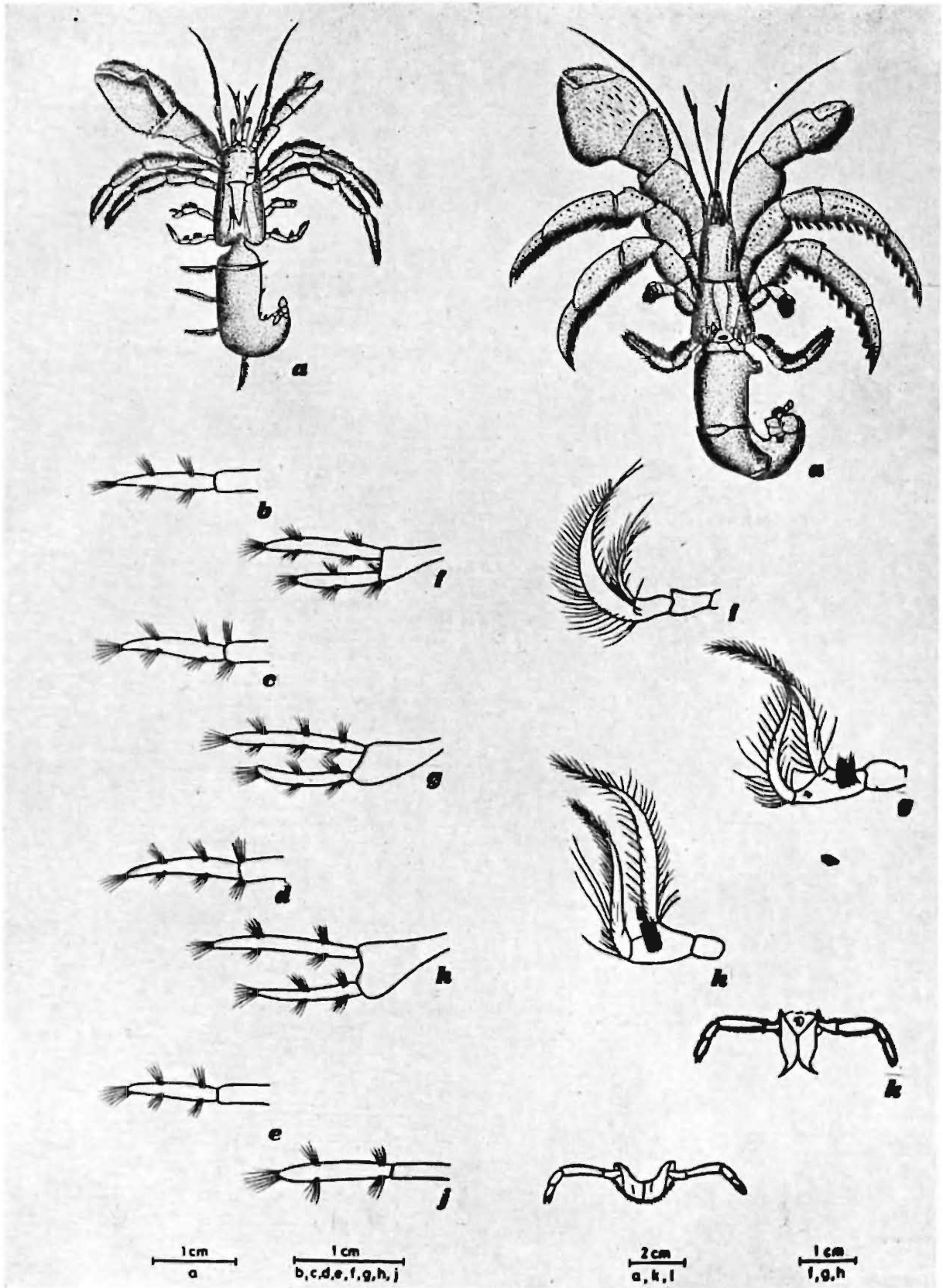


Fig. 17

Fig. 18

Fig. 19. *Pagurus carpotoraminatus* (Alcock)

a.—Cephalic region of animal ;

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

Fig. 20. *Spiropagurus spiriger* (De Hann)

a.—Entire animal ; b, c, d, e—I, II, III, IV pleopods of males respectively ; f, g, h, j—I, II, III, IV pleopods of females respectively.

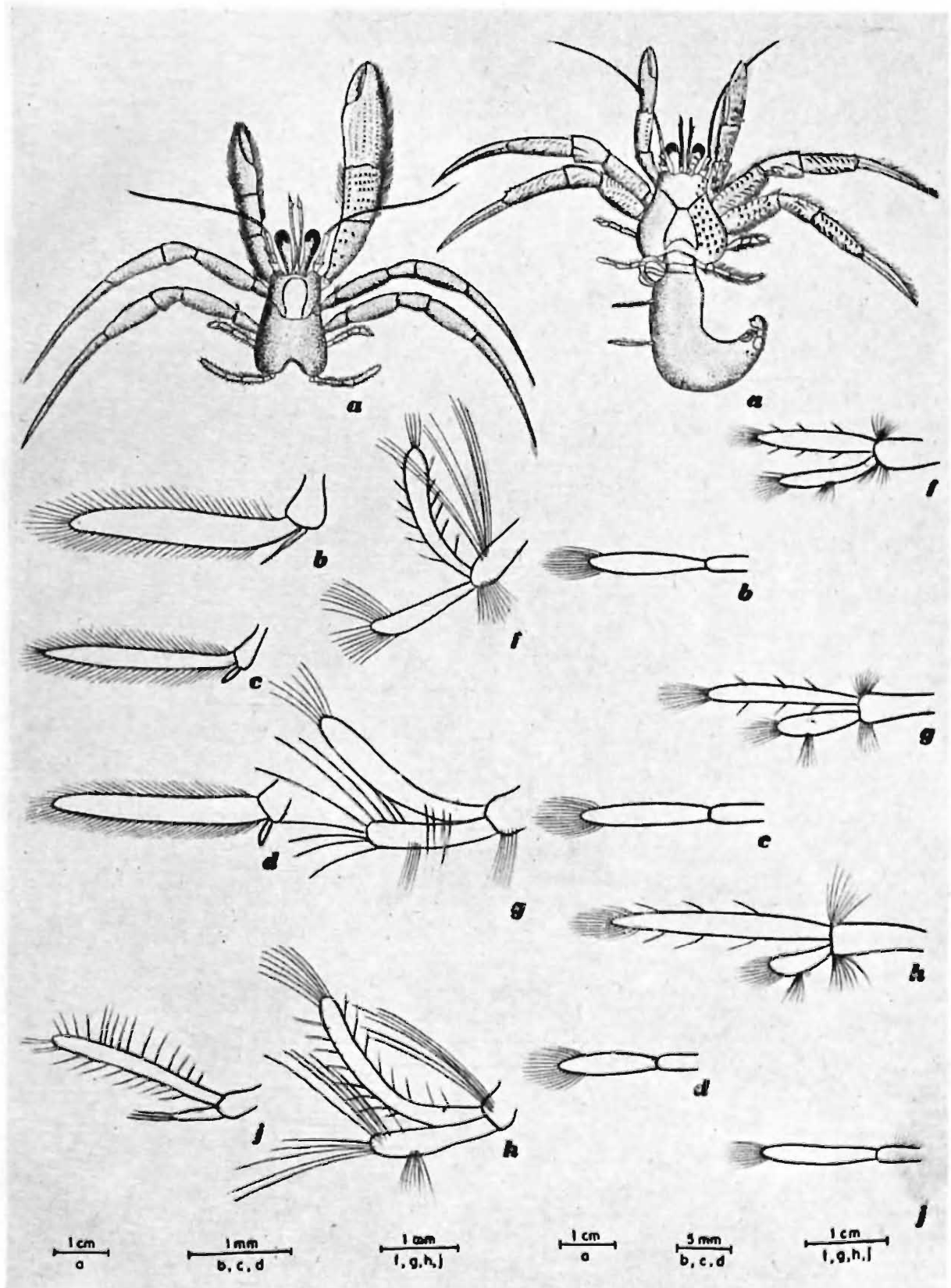


Fig. 19

Fig. 20